SULIT

Second Semester Examination
2017/2018 Academic Session

May/June 2018

EES 510 – INTERNET OF THINGS

Duration : 2 hours

Please check that this examination paper consists of SIX (6) pages printed material before you begin the examination.

Instructions: This question paper consists **FOUR (4)** questions. Answer **THREE (3)** questions. All questions carry the same marks.

1. (a) Define Internet of Things (IOT) and describe the functions of component elements in IOT hardware platform.

(10 marks)

(b) Wireless Sensor Network (WSN) is classified as one form of automated sensing instrumentation system devices. Briefly explain why the WSN system is not considered as IoT devices.

(20 marks)

(c) Automotive Manufacturing Sdn Bhd utilizes WSN system for real time Monitoring condition of machine in a production line. Describe briefly, the easiest way to make the monitoring system IoT-enabled, such that the machine condition in the production line can be queried via the Internet.

(30 marks)

(d) Give an example of a use case where WSN devices augmented with RFID features is necessary for addressing specific requirements that cannot be addressed using WSN devices alone.

(20 marks)

(e) List and briefly describe all communication protocol functions in IOT.

(20 marks)

2. (a) A battery-operated IoT device typically uses the IEEE 802.15.4 standard for its network interface.

(5 marks)

What is the maximum data rate achievable by IEEE 802.15.4 devices?

If the IEEE 802.15.4-based IoT device is to be sold worldwide, state one (1) issue that would need to be addressed in order to minimize the number of different hardware configurations for the device.

(10 marks)

State three (3) reasons why the common IEEE 802.11 standards such as 802.11 a/b/g/n/ac are not suitable for use by most battery-operated IoT devices.

Given that 802.11ah has been designed for use by IoT devices, state three (3) characteristics of 802.11ah that are well suited for IoT applications.

(15 marks)

(b) Given the following use case, propose a suitable IoT system that can meet the requirements.

Hutan Belum, Grik is renowned as one of the oldest forests in the world. Its environmental parameters can be as reference parameters for global warming parameters such as O_2 level, CO_2 level, humidity, temperature and noise pollution. The Perak state wishes to setup an IoT-based system to collect data as reference for global warming data. Areas to be covered electrical infrastructure and low density. Population density to the data will be sent the hub centre at CEDEC, USM. Perak state requests for a real-time video streaming of 117,500 hectare area of Hutan Belum.

The solution should include the following:

(i) IoT Device hardware platform requirements (MCU processing capabilities: 8/16/32 bit), sensor types, communications technology/ technologies, power source

(ii) Communications technology (standard used, RF spectrum frequency range, etc.) & network topology for communications between sensors and the monitoring station

(iii) IoT Data Processing Communications model best suited for the two use cases:

(a) Periodic sensor data updates to monitoring station
(b) On-demand video streaming for specific areas

Justification should be provided for the various proposed components of this IoT system.

(30 marks)

(c) Figure 2 (c) shows a type of ADC :

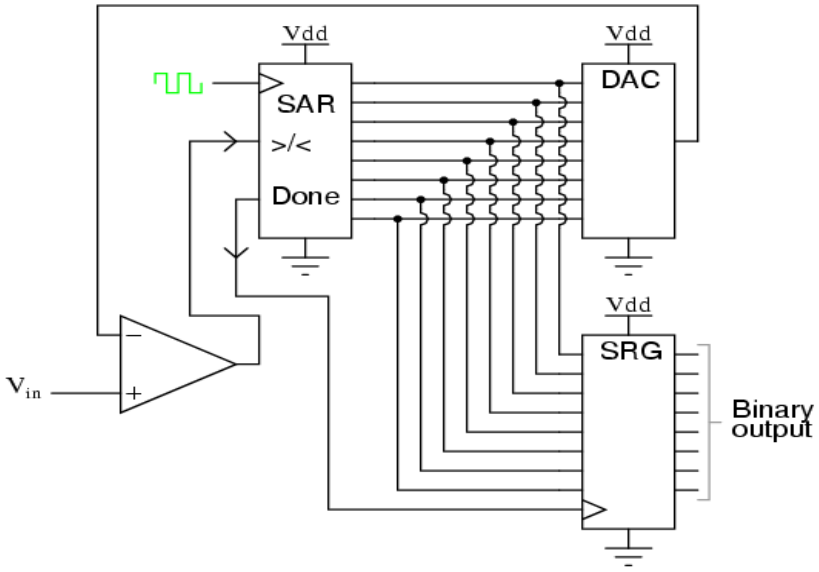

Figure 2 (c)

(i) State the type of ADC represented in Figure 2 (c) and explain the operation mechanism of this ADC.

(10 marks)

(ii) State 2 advantages and disadvantages of ADC.

(10 marks)

(d) Analog to Digital Converter (ADC) is an important element in signal processing for digital conversion of sensor signal. In the case of digitizing a vibration signal measured by an accelerometer with the following characteristics (PCB 301A10):

– Sensitivity: (±2.0%) 100 mV/g
– Measurement Range: ±50 g pk
– Frequency Range: (±5%) 0.5 to 10000 Hz

Design an appropriate ADC for this sensor application. This design needs to specify the number of bit, resolution, minimum sampling frequency and ideal sampling frequency for ADC.

(20 marks)

3. (a) What are the functions of communication protocol in IoT?

(10 marks)

(b) IoT devices can be connected using different types of network topologies.

(i) List and explain these topologies.

(ii) What topology would be best suited for Wireless Sensor Network. Explain your answer.

(20 marks)

(c) Describe Ad-hoc On-demand Distance Vector (AODV) routing algorithm.

(10 marks)

(d) Internet Protocol version 6 (IPv6) is vital in driving IoT. This has led to the development of 6LowPan. Briefly describe what IPv6 and 6LowPan are.

(10 marks)

(e) NAT64/DNS64 is needed to bridge IoT devices with 6LowPAN to IPv4 Internet. Illustrate with a diagram how this can achieved.

(15 marks)

(f) What are the network security issues with IoT devices?

(10 marks)

(g) The Mirai botnet attacked IoT devices, especially connected CCTV cameras. Discuss this botnet and suggest the defenses against such attack.

(20 marks)

(h) List **FIVE(5)** IoT data protocols.

(5 marks)

4. (a) List and describe **THREE (3)** components of Internet of Things.

(10 marks)

(b) REST stands for Representational State Transfer.

(i) Describe how REST works.

(ii) What are the elements of REST?

(20 marks)

(c) Convert the data shown in the following table into:

NAME	VALUE	COLOR	DATE
Temperature	12	blue	Sep. 25, 2016
Pressure	13	green blue	Sep. 27, 2016
Lumens	45	orange	Sep. 29, 2016
Pressure	27	teal	Sep. 30, 2016

(i) eXtended Markup Language (XML) Format

(ii) JavaScript Object Notation (JSON) Format

(20 marks)

(d) Explain what MQTT is and its purpose.

(10 marks)

(e) Why MQTT is preferred for messaging protocol compared to XML or JSON in IoT?

(10 marks)

(f) Describe the Publish/Subscribe model of MQTT.

(15 marks)

(g) Write the commands for the following actions in Mosquito Broker.

(i) Starting the broker.

(ii) Subscribing to a Topic called “IoT Security”

(iii) Publish a message “IoT Good” at QoS 1 retained.

(15 marks)

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